Time-Temp Thing

Model TTT-1

– INSTALLATION AND OPERATION –

This documentation is valid for
Audio Control Unit hardware version 1.03 with firmware version 1.01

Sine Systems, inc

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Table of Contents

Section 1 — Safety Information

WARNING!

The Time-Temp Thing should be installed only by qualified technical personnel. An attempt to install this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the TTT-1 or other equipment. Please ensure that proper safety precautions have been made before installing this device.

The TTT-1, as any electronic device, can fail in unexpected ways and without warning. Do not use the Thermal Sentry in applications where a life-threatening condition could result if it were to fail.

The TTT-1 is designed for indoor use in a dry location. Installation and operation in other locations could be hazardous. Use only the original wall-plug power supply supplied with the unit.

The purchaser and user of the TTT-1 bears the sole responsibility for determining suitability of this equipment for their intended use. Because this equipment can fail in an unpredictable or unexpected way, even in normal use, Sine Systems, Inc. cannot be held responsible for damages, either direct or indirect, resulting from use of this equipment.

Section 2 — System Description

2.1 General Description

The Time-Temp Thing is a talking clock/thermometer for use with a program automation system. The Time-Temp Thing will deliver the time, the temperature, or both on command from the automation system. When time and/or temperature delivery is complete, the Time-Temp Thing gives an end-of-message signal to the automation system to resume programming. The Time-Temp Thing can be programmed to give the temperature in Fahrenheit or Celsius. The time is reported to the nearest minute.

The Time-Temp Thing main unit is 19 inches wide and 1.75 inches tall and can be mounted in a a single space (1U) of a standard EIA equipment rack. The front panel has six pushbuttons for setting the time and calibrating the temperature, and an LED indicator. The rear panel contains 12 screw-terminal connections for the various electrical inputs and outputs.

The TTT-1 comes with one temperature sensor that should be located outside. It should be mounted inside a standard enclosure for the most accurate temperature measurment. Details of the standard enclosure are provided later in this manual.

To make the Time-Temp Thing more natural sounding, it does not speak the time and temperature the same way each time. The output script is automatically rotated each time it speaks. Here are the possible output scripts:

Time Only	*Length*
It's 3:27	1.5 seconds
The time is 3:27	2.0 seconds

Temperature Only	*Length*
The temperature is 72 degrees	2.0 seconds
It's 72 degrees outside	2.0 seconds

Time and Temperature	*Length*
It's 3:27 and the temperature is 72 degrees	3.0 seconds
The time is 3:27 and it's 72 degrees outside	3.5 seconds
It's 72 degrees outside at 3:27	3.0 seconds
At 3:27 the temperature is 72 degrees	3.0 seconds

2.2 Electrical Description

Two sets of input terminals on the rear-panel of the TTT-1 are used to make it deliver the time and/or temperature. These terminals are pulled-up to +5 volts and are activated by momentarily pulling them to ground. This can be done with a contact closure, an open-collector, an optocoupler, or a 5 volt logic-level output. Grounding the "Give Time" terminal causes the TTT-1 to deliver the time and grounding the "Give Temp" terminals causes it to deliver the temperature. Grounding both terminals at the same time causes the TTT-1 to deliver both the time and the temperature.

These inputs are internally de-bounced and have transient-voltage and RFI protection. Optocoupler isolation should not be required except in cases of extremely long wire runs.

2.2.1 Audio Output

The Time-Temp Thing has two audio outputs. The first is a transformer balanced, 600 ohm, +4 dBm line-level output designed for connection to an automation system. A secondary unbalanced output is available for driving a small speaker (at low level) or a pair of headphones. The latter output is useful when calibrating the clock and thermometer.

2.2.2 End-of-Message (EOM) Output

The end-of-message (EOM) output is a floating, single-pole relay contact. It is a normally open contact that closes for 0.5 seconds at the end of audio.

2.2.3 Back-Up Battery

The Time-Temp Thing contains an internal holder for a user-supplied 9-volt battery. This allows the clock to maintain accurate time in the event of a power failure. If a rechargable battery is installed, the Time-Temp Thing will automatically keep the battery charged.

2.3 Front Panel Switches and Indicators

The front panel of the TTT-1 has six momentary pushbutton switches that are used to set the clock and to calibrate the clock and the thermometer.

- SET HOURS selects the clock hours for adjustment
- SET MINS selects the clock minutes for adjustment
- SET SPEED selects the clock calibration
- SET TEMP selects the thermometer calibration
- UP/DOWN make incremental adjustments when used with one of the selection buttons

The front panel of the TTT-1 Time-Temp Thing has a single LED indicator that has several purposes.

- The LED illuminates to indicate that external power is present and the unit is operating.
- The LED is dark when the system is operating from its backup battery.
- The LED blinks off briefly every minute at zero seconds.
- The LED blinks off briefly when an EOM signal is sent.
- The LED blinks off briefly when a valid calibration command is received.

2.4 Rear Panel Connections

The rear panel of the TTT-1 contains all the I/O connections to the device. All connections are made via a single row of removable screw terminal connectors.

- Power Supply input
- Temperature Sensor input
- Give Time/Give Temp control inputs
- Audio/Speaker outputs

Section 3 — Installation

WARNING!

The Time-Temp Thing should be installed only by qualified technical personnel. An attempt to install this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the Time-Temp Thing or other equipment. Please ensure that proper safety precautions have been made before installing this device.

3.1 System Includes

The Time-Temp Thing package contains these items:

- Time-Temp Thing model TTT-1
- temperature sensor
- 12 volt DC power supply
- operation manual

3.2 Installing the Unit

The TTT-1 is designed to be mounted in a standard 19 inch EIA equipment rack. It is 1.75 inches (1U) high. The TTT-1 generates little heat and can be mounted in just about any convenient location where the ambient temperature does not exceed 140°F.

All electrical connections to the TTT-1 are made via 12 removable screw terminal connectors located on the rear of the unit. These connections include:

- Temperature sensor
- Time/Temp delivery control inputs
- EOM output
- Audio output
- Power supply

3.2.1 Audio Output

The main audio output is a transformer-balanced, 600 ohm, +4 dBm source designed for direct connection to external equipment. This audio output appears on terminals 11 and 12 of the rear-panel terminal strip. An optional speaker (+) output appears on terminal 10. This output is capable of driving an 8 ohm speaker at low volume level. The low side of the speaker (-) should be connected to terminal 8 (ground).

3.2.2 Temperature Sensor Connection

WARNING!

Single pair, foil shielded cable such as Belden 8451 should be used for the connection. It is very important that foil-shielded cable be used. Braid-shielded cable is inadequate. The shield conductor is electrically offset from ground by 0.7 volts so care should be taken that it connect only to the appropriate terminals on each end. Be particularly careful not to cut or puncture the outer insulating jacket of the cable anywhere it is outdoors except where it connects to the sensor.

The temperature sensor consists of a small PC board with three screw terminals. It may be located up to 150 feet from the main unit. Connect the sensor the the TTT-1 main unit with foil shielded cable per the following diagram. The shield connects sensor "G" to terminal 1, the black conductor connects sensor "S" to terminal 2 and the red conductor connects sensor "+" to terminal 3.

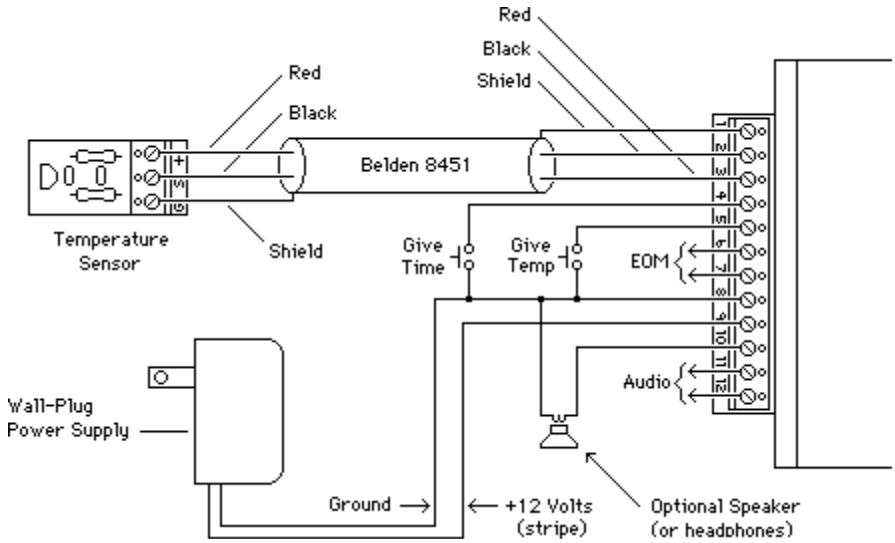


Figure 3.1; TTT-1 installation overview

3.2.3 Control Inputs

The control inputs are used to tell the Time-Temp Thing to deliver the time, the temperature or both. In the illustrations that follow, switch contacts are shown as the trigger mechanism. Typically, the Time-Temp Thing would be triggered by an automation system. Either floating relay contacts or a ground referenced open collector output may be used to trigger the Time-Temp Thing.

Here are three examples of how the control connections can be made from the automation system to the TTT-1:

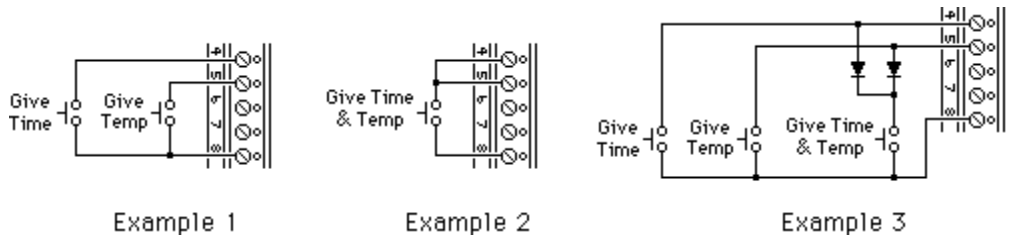


Figure 3.2; Variations for external control inputs

In the first example, either time or temperature may be requested. In the second example, time and temperature can be requested together. In the third example, any combination can be requested.

3.3.4 End-Of-Message (EOM) Output

When the Time-Temp Thing completes message delivery, it provides a momentary relay closure across terminals 6 and 7 (labeled "EOM" in Figure 3.1). This closure can be used to cue the automation system to resume programming.

3.3.5 Back-Up Battery Installation

The Time-Temp Thing can use an internal, rechargable battery to power the internal clock in the event of a power failure. A battery is not supplied with the unit and must be purchased separately. A 9 volt NiCad rechargable battery is preferable but an alkaline battery will also work. If a NiCad is used, the Time-Temp Thing will charge the battery when power is available. A fully charged NiCad battery will keep the Time-Temp Thing running for about 10 hours. *If an alkaline, or other non-rechargable battery is used, R10 on the Time-Temp Thing PC board should be removed to prevent charging current.*

Do not install the battery until the Time-Temp Thing is to be powered-up permanently. To install the battery, remove the two screws on the rear panel. Slide the rear panel, plastic bezel, and main PC board out the back of the case. Install the battery in the holder on the PC board. Reinstall the board, bezel and rear panel.

3.3.6 Power Supply Connection

WARNING!

Do not ground either the "+" or the "-" power supply connections. Connect them only to the indicated terminals on the rear panel of the Time-Temp Thing.

The TTT-1 is powered by 12 volts DC. The included wall-plug power supply should be used. If the power supply cord has a connector attached, cut it off and strip the leads. The wire with the white stripe is positive and should be attached to the "+" terminal. The other wire should be attached to the "-" terminal.

3.3 Placing the Temperature Sensor

WARNING!

Two-conductor-with-foil-shield cable, such as Belden 8451, should be used for the connection. It is very important that foil-shielded cable be used. Braid-shielded cable is inadequate.

The TTT-1 temperature sensor can be placed up to 150 feet from the main unit. Single-pair foil-shielded cable should be used to connect the sensor to the main unit. The shield conductor is electrically offset from ground by 0.7 volts so care should be taken that it connect only to the appropriate terminals on each end. Be particularly careful not to cut or puncture the outer insulating jacket of the cable anywhere it is outdoors except where it connects to the sensor.

3.3.1 Standard Enclosure

To get readings that correspond to those reported by the nearest NOAA weather station, it is important to measure the temperature the same way they do. Just hanging the sensor out a window will almost surely produce temperatures that fluctuate wildly. The key measuring the temperature accurately is to mount the sensor in a standard enclosure. It provides very accurate air-temperature readings.

An alternative to buying a standard enclosure is to make one using inexpensive materials. The primary raw material is two 12 inch wide louvered wood shutters—louvered doors might also work. Cut the shutters so you end up with four equal lengths of shutter about 13 to 16 inches long. A little improvising may be required depending on the style of shutter or door. Some can be cut along a solid horizontal reinforcement piece and others will require the end louvers to be stabilized with glue or a piece of wood. In either case, you will build a box with the four pieces of shutter using them for the four walls. The floor and roof of the box are made of 3/8 inch exterior grade plywood.

Attach three of the four sides together with glue and nails or screws. The pieces of shutter should be oriented so the louvers will drain outside of the enclosure. Attach this assembly to the floor. The roof should overhang about 3 inches on all sides. Attach the roof with a couple of 1/4 inch spacers near the front so that it slopes slightly to the rear. This will prevent water from standing on top. The remaining wall should be attached with two hook-and-eye sets so it can be removed.

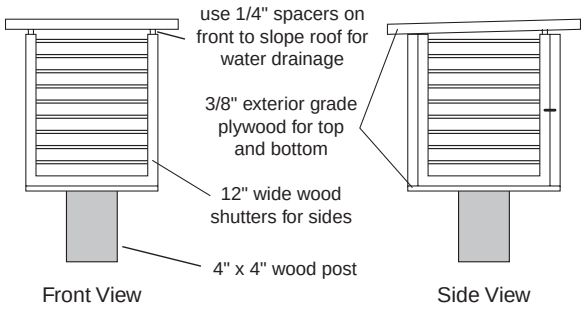


Figure 5.2; Standard enclosure for temperature sensor

Mount the enclosure on a 4 inch square wooden post. The floor of the enclosure should be 4 feet above the ground.

Drill a small hole in the floor near the edge of the post for the sensor cable to come through. A 1/4 inch hole drilled in one of the walls about an inch above the floor makes an easy way to insert a calibration thermometer without removing the louvered panel (see section 3.3.2). The enclosure should be given at least two coats of white exterior paint inside and out.

Place the enclosure at least 20 feet from the nearest building, preferably on grass covered soil. It should be as far away as possible from concrete and pavement. Do not place the enclosure near air-conditioner compressors or under trees.

Run the cable for the sensor up the post and through the hole in the floor. Lay the sensor in the center of the floor of the enclosure. Be careful not to cut or puncture the outer insulating jacket of the cable. The inner conductors must be protected from the weather. If an extension cable is used, wrap electrical tape around the connectors to seal out moisture.

When visiting the enclosure during the summer months you might want to take a can of wasp and hornet killer with you. They just love to build nests in these things.

3.4 Setting up the System

A speaker should be connected to the appropriate audio output when making adjustments to the system.

3.4.1 Setting the Clock

To set the time in the TTT-1, press and hold the SET HOURS button. Press the UP or DOWN buttons until the TTT-1 reads the desired hours. Release the SET HOURS button.

To set the minutes, press and hold the SET MINS button. Press the UP or DOWN buttons until the TTT-1 reads the desired minutes. Release the SET MINS button. The seconds are reset to zero each time the minute is changed.

3.4.2 Calibrating the Clock

Like most microprocessor based clocks, the TTT-1 may drift over time due to variances in components. The TTT-1 can be adjusted to compensate for this and minimize drift.

To adjust the clock speed, press and hold the SET SPEED button. Press the UP button to speed the clock up or press the DOWN button to slow the clock down. Each button press increments or decrements the clock speed by 0.33 seconds per day. For instance, pressing the DOWN button six times will slow the clock by 2 seconds per day. When the ajustment is complete, release the SET SPEED button

3.4.3 Calibrating the Thermometer

To calibrate the TTT-1 temperature sensor, a thermometer of known accuracy should be placed as close as possible to the temperature sensor. Give the thermometer about ten minutes to stabilize in temperature. Then set the TTT-1 to read the same temperature as the thermometer.

To adjust the temperature, press and hold the SET TEMP button. Press the UP or DOWN button until the TTT-1 reads the same temperature as the thermometer. Release the SET TEMP button.

An alternate method to calibrate the temperature sensor is to fill a styrofoam cup with crushed ice and water. Insert the sensor into the cup and allow a couple of minutes for the temperature to stabilize. Shield the sensor and cup from direct sunlight. Set the TTT-1 to read a temperature of 32 degrees F (or 0 degrees C) using the procedure above.

The temperature calibration and scale are stored in non-volatile memory and will not be lost during a power failure, even if the back-up battery is not charged.

3.4.4 Setting to Fahrenheit/Celcius

To toggle the thermometer between Fahrenheit and Celcius, press the SET TEMP and SET SPEED buttons at the same time. The TTT-1 will respond with “Temperature 1” for Fahrenheit or “Temperature 2” for Celcius.

3.4.5 Read Firmware Version

Press UP and DOWN at the same time to have the TTT-1 read the firmware version.

3.4.6 System Reset

Press SET HOURS and SET MINS at the same time to reset the system. Time and temperature calibration are not affected by a system reset.

Section 4 — Circuit Description and Repair

4.1 Repair Safety Warnings

WARNING!

The Time-Temp Thing should be installed or repaired only by qualified technical personnel. An attempt to repair this device by a person who is not technically qualified could result in a hazardous condition to the installer or other personnel, and/or damage to the Time-Temp Thing or other equipment. Please ensure that proper safety precautions have been made before installing or repairing this device.

4.2 Circuit Description

The Time-Temp Thing is powered by 12 to 15 volts DC. D6 is a 16 volt, 5 watt zener that clamps voltage surges and protects against accidental reverse polarity. D5 and D7 form a diode "OR" which provides voltage to the input of the voltage regulator (U5) from the higher voltage available. In normal conditions, this would be the external power source. D7 is a Schottky diode which has a lower forward voltage drop and allows operation down to a lower battery voltage. U5 is a +5 volt low-dropout regulator, again, selected to allow the microprocessor to function on the lowest-possible battery voltage.

U1 is a single-chip microcomputer which contains program ROM, RAM, EEPROM, timers, I/O, etc. The timebase is a 3.579545 MHz crystal oscillator. U3 is a "low voltage interrupt" which shuts down the microprocessor when the supply voltage drops below 4.5 volts. U2 is the speech synthesizer chip which operates under control of U1.

U4 is a power amplifier which drives both the audio output transformer and the unbalanced output. Q1 and Q2 respectively control the front panel LED and the EOM relay. The temperature sensor supplies a 10 millivolt per degree Fahrenheit signal on pin 2, referenced to pin 1. Pin 1 is elevated above ground 0.65 volts to allow for below zero temperature readings. The microprocessor measures the voltage at pin 1 and pin 2 and then computes the temperature using the calibration constant stored in EEPROM.

4.3 Factory Service Policy

These policies are effective August 1999 and are subject to change without prior notice.

4.3.1 Factory Warranty

Sine Systems, Inc. guarantees our products to be free from manufacturing defect for a period of one year from the original date of purchase from Sine Systems, Inc. This warranty covers the parts and labor necessary to repair the product to factory specifications. This warranty does not cover damage by lightning, normal wear, misuse, neglect, improper installation, failure to follow instructions, accidents, alterations, unauthorized repair, damage during transit, fire, flood, tornado, hurricane or acts of God and/or nature.

4.3.2 Factory Return Policy

The factory return policy only applies to equipment purchased directly from Sine Systems, Inc. Equipment purchased through a third party (dealer) is subject to the return policy of the dealer and arrangements for return or exchange must be handled through the dealer.

Sine Systems policy on returns and exchanges with the factory is broken down according to the following schedule:

30 days "no questions asked"

During the first thirty days from the date that equipment ships from our factory we will accept it back for a full refund less shipping charges provided that the equipment is still in new, resellable condition with no cosmetic damage. This does not constitute an evaluation program. It is for legitimate purchases only.

less than 60 days, may be returned less 15% restocking fee

Between 31 and 60 days from the time we ship the equipment, we will accept unmodified equipment back for a refund less shipping charges and 15% of the invoice cost. This is to cover the cost of restocking the items which must then be sold at a discount as reconditioned instead of new.

no return after 60 days

We will recondition the equipment for you according to our repair rates but we will not accept it for refund or exchange after 60 days from the initial purchase.

4.3.3 Factory Service Policy

Sine Systems is proud to offer same day repair service on all of our products. When we receive damaged equipment, we will repair it and ship it back the same day it arrives. Because we offer immediate service, we do not send loaner equipment. If we cannot immediately repair equipment and return it, we may ship a loaner unit at our discretion.

While we do not require prior authorization on repairs, we suggest that you verify our shipping address before returning equipment for repair. Sine Systems is not responsible for items lost in transport or delivered to the wrong address. Emergency service may be made available on weekends or holidays, at our discretion, if arrangements are made with us in advance.

4.3.4 Warranty Service

There is no charge for repair service on items covered under warranty. You are responsible for shipping charges to return damaged equipment to us for repair. Damage due to negligence, lightning or other acts of nature are not covered under warranty.

4.3.5 Service Rates

For service not covered under warranty we have a flat rate repair fee. Flat rate repairs cover only components that fail electrically. Mechanical damage will be assessed on a per repair basis. Repair charges typically fall into one of these categories. Shipping fees are not covered in the repair rate.

Minor programming adjustments or no damage, $50 plus shipping

Sometimes a system works exactly like it is supposed to when we get it or it can be fixed through a simple adjustment in firmware. We will do our best to identify intermittent hardware problems and correct them. The fee covers the time it takes our technician to thoroughly inspect and test the equipment.

Minor repairs are up to $150 plus shipping

Five or fewer defective components are replaced in a minor to moderate repair. This accounts for most of our repairs. These repairs may cost less depending on the components replaced and the amount of time required to complete the repair.

Moderate repairs are $250 plus shipping

Six to ten defective components are replaced in a major repair. Again, we may charge less depending on the components replaced and the amount of time required to complete repairs.

Major repairs cost more than $250 plus shipping

This occurs rarely but it can happen. If the equipment has blown traces and scorch marks from burned components, it's a safe bet that it will take several components and quite a bit of bench time to repair. We assess this type of repair on a per incident basis.

Damaged beyond recognition, assessed on a per case basis

Hopefully you have insurance. In cases where the board is so badly damaged that it is not worth repairing we may, at our discretion, offer to replace the destroyed circuit board. The options and costs vary widely in these cases so we will call with options.

All repairs must be billed to a credit card or shipped COD. Specify which you prefer with your request for service. At your request, we will call with the total amount of the repair (including applicable shipping charges) so that suitable payment can be arranged before a COD shipment. If you need a COD total, do not forget to include a telephone number where you can be contacted.

4.3.6 Instructions for Factory Service

Please include a note with any specific information available about the equipment failure as an aid to our technicians. Pack equipment carefully to avoid further damage in shipping. We are not responsible for damage during transport.

When returning a system with multiple components, we strongly suggest that you return the entire system. We will repair the parts that are returned but lightning is rarely selective enough to damage only a single part of a system.

Be sure to include a street address for return shipping by UPS. The repair will be delayed if you neglect to give us enough information to return your equipment--this actually happens! If you prefer a carrier other than UPS or wish us to bill to your shipping account, we can usually accommodate these requests. Many carriers do not accept COD shipments so credit card billing may be required for carriers other than UPS. If you do not specify otherwise, return shipments will be made by the UPS equivalent of the received shipping method.

We suggest that you verify our shipping address before sending equipment for repair. Same day service does not apply if you ship to an incorrect address and/or the carrier delivers the equipment too late in the day for repairs to be completed. Sine Systems is not responsible for equipment that is not delivered to our factory. It will be your responsibility to contact the carrier to retrieve your improperly delivered equipment.

Section 5 — Specifications

5.1 Electrical Specifications

Ports

Temperature Sensor (5.0mm screw terminal connectors)
Trigger Inputs (5.0mm screw terminal connectors)
Audio Outputs (5.0mm screw terminal connectors)
EOM Output (5.0mm screw terminal connectors)
Power Input (5.0mm screw terminal connectors)

Line-level audio output is transformer balanced, +4 dBm nominal level. Load impedance should be 600 ohms or greater.

Speaker audio output is unbalanced, low level audio to drive ~8 ohm load. This output is short-circuit protected.

EOM relay output contacts are rated at 0.5 amperes, 24 volts AC/DC. Relay closure lasts one-half second.

Switches

Up/Down (momentary pushbutton)
Hours/Mins (momentary pushbutton)
Set Speed/Set Temp (momentary pushbutton)

Indicators

Power LED (yellow)

Adjustments

Temperature calibration (in firmware)
Clock speed (in firmware)

Sensor

Operating range: -40°F to 150°F (-40°C to 65°C) ambient air temperature
Absolute accuracy (at 72°F): ±1°F

AC Power

Input: 100-240 Volts AC, 50-60 Hz, 5 watts
Output: 12 Volts DC, 80 mA max

5.2 Mechanical Specifications

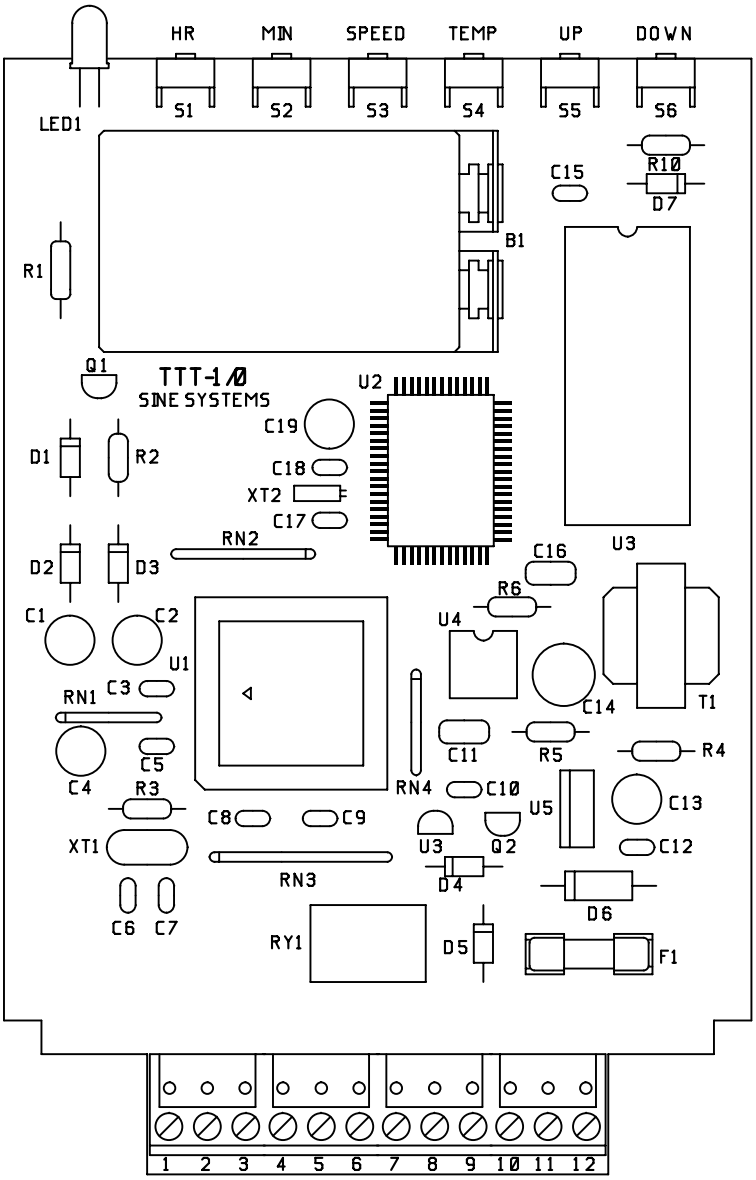
Dimensions

19.0” (w) x 6.0” (d) x 1.75” (h)
mounts in standard 19” EIA rack

Weight

3 lbs.

5.5 Component Layout



Part Description and Value	*Quantity*
board, PC, TS-1 Sensor (10/panel), Rev. 5	1
capacitor, aluminum, radial, 1 µF, 50v	1
capacitor, aluminum, radial, 10 µF, 16v/short	3
capacitor, aluminum, radial, 100 µF, 16v/short	1
capacitor, aluminum, radial, 220 µF, 16v	1
capacitor, monolythic ceramic, 0.022 µF, .1" spacing	1
capacitor, monolythic ceramic, 0.1 µF, .1" spacing	9
capacitor, monolythic ceramic, 10 pF, .1" spacing	1
capacitor, monolythic ceramic, 1000 pF, .1" spacing	1
capacitor, monolythic ceramic, 27 pF, .1" spacing	2
capacitor, polyester, 0.047µF, 50V, 5%	1
capacitor, polyester, 0.12 µF, 50V, 5%	1
connector, battery holder, 9 volt, metal, PCB	1
connector, screw terminal, 5.0 mm, 3, plugable	4
connector pins, screw terminal, 5.0 mm, 3, PCB, 0°	4
crystal, 120.0 kHz, 11 pF, C-2/SMD	1
crystal, 3.579 MHz, 18 pF series, HC-49/U	1
diode, general purpose, 600 V/1 A, 1N4005	4
diode, Shottky, 40 V/1 A, 1N5819	1
diode, zener, 16 V/5 W, 1N5353B	1
diode, zener, 3.9 V/1 W, 1N4730A	1
enclosure, assembly, black, Q1 MicroPak, 5.0"	1
enclosure part, front panel, Q1 MicroPak, anodized for TTT-1	1
enclosure part, rear panel, cut, Q series MicroPak, 4.0" x 1.120	1
fuse, polyswitch, resettable, 0.1 amp, 60 V	1
hardware, heat shrinkable tubing, 0.75" dia., 1.75" long	2
hardware, screw, pan head, thread rolling, 4-40 x 5/8", black	2
integrated circuit, amp, 0.5 watt audio, LM386N-1,	1
integrated circuit, EPROM, 4 meg (512K x 8), CMOS, 27C040, 32 pin DIP	1
integrated circuit, low voltage interrupt, MN1381-S, CMOS output	1
integrated circuit, microprocessor, MC68HC811E2FN,	1
integrated circuit, speech synthesizer, MSM6376GS-V1K, external ROM storage	1
integrated circuit, temperature sensor, analog, LM34DZ,	1
integrated circuit, voltage regulator, low drop, LM2931AT-5.0, +5V DC/0.1 A	1
LED, T1-3/4, yellow, diffused	1
miscellaneous, tape, double-sided, 1" x 432 feet, 3M #4950	2
relay, part 68, sealed, 12 volt DC, form 1C	1
resistor, carbon film, 1/2W, 430, 5%	1
resistor, carbon film, 1/4W, 10, 5%	1
resistor, carbon film, 1/4W, 15K, 5%	2
resistor, carbon film, 1/4W, 1M, 5%	1
resistor, carbon film, 1/4W, 47, 5%	1
resistor, carbon film, 1/4W, 51K, 5%	1

Part Description and Value	*Quantity*
resistor, carbon film, 1/4W, 75, 5%	2
resistor, SIP, 3 x 3.3K, isolated	1
resistor, SIP, 3 x 4.7K, isolated	1
resistor, SIP, 5 x 22K, isolated	1
resistor, SIP, 7 x 4.7K, common	1
socket, DIP, 32,	1
socket, DIP, 8,	1
socket, PLCC, 52,	1
switch, pushbutton, momentary, SPST, NO, PCB, 90°	6
transformer, audio, PC, 8:500 ohms,	1
transformer, wall plug, 12V DC, 500 mA	1
transistor, NPN, PN2222A, TO-92	2